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A bibliometric study on research of Cloud Computing in Libraries

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Abstract

Cloud Computing is internet based computing where virtual shared servers provide software, infrastructure, platform devices and other resources and hosting to customers on a pay-as-you-use basis. All information that a digitized system has to offer is provided as a service in the cloud computing model. Users can access these services available on the "Internet Cloud" without having any previous know- how on managing the resources involved.

Publication is essential to productivity in research, the work will be recognized only when it takes a conservative, physical form which can be received , accessed and recongised by professionals. This study aims to recognize the distribution of authorship pattern in research on cloud computing in libraries from web of science database which is a scientific and indexing service maintained by Thomson reuters. In this study the data has been collected for a period of 18 years from 2002 to 2019, a total of 252 records were retrieved and analysed using histcite software application and the results are tabulated based on the objectives.

Keywords: cloud computing in libraries , bibliometrics, collobarative index, doubling time

Introduction

Libraries are using computers for running services such as Integrated Library Management Software (ILMS), website or portal, digital library or institutional repository, etc. These are either maintained by parent organization's computer staff or library staff. It involves investment on hardware, software, and staff to maintain these services and undertake backup and upgrade as and when new version of the software gets released. Library professionals in most cases not being trained in maintaining servers find it difficult to undertake some of these activities without the support of IT staff from within or outside the organization. Now cloud computing has become a new buzzword in the field of libraries, which is blessing in disguise to run different ICT services without much of a problem as third-party services will manage servers and undertake upgrades and take backup of data.

Cloud Computing is internet based computing where virtual shared servers provide software, infrastructure, platform devices and other resources and hosting to customers on a pay-as-you-use basis. All information that a digitized system has to offer is provided as a service in the cloud computing model. Users can access these services available on the "Internet Cloud" without having any previous know- how on managing the resources involved.

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The word bibliometric has been derived from the latin and Greek word, biblio and metrics refers to the application of mathematics to the study of bibliography. The quantititavie analysis and statistics to describe patterns of publication with a given field of body of literature are utilized. Researchers use bibliometric methods of evaluatuion to determine the influence of a single author or to describe the relationship between two or more authors or works.

Review of Literature

The analyses the growth pattern of cloud computing literature during 2009-2013 downloading the data from web of science database. The total publication t of top ten countries 1879 publications and first place USA. The growth in the publication is studied through Relative Growth Rate and doubling time. The authorship pattern is measured by different collaboration parameters like collaborative index and modified collaborative coefficient**. (Jan, Rosy, 2015)**[1].

The popularity and rapid development of cloud computing in recent years has led to a huge amount of publications containing the achieved knowledge of this area of research. Due to the interdisciplinary nature and high relevance of cloud computing research. we provide extensive insights into publication patterns, research impact and research productivity. Furthermore, we explore the interplay of related subtopics by analyzing keyword clusters. The results of this study provide a better understanding of patterns, trends and other important factors as a basis for directing research activities, sharing knowledge and collaborating in the area of cloud computing research.**(Leonard Heilig and Stefan Voß, 2014)**[2].

Cloud computing is a new technique of Information Communication Technology because of its potential benefits such as reduced cost, accessible anywhere anytime as well as its elasticity and flexibility. In this study defines cloud Computing, Definition, Essential Characteristics, model of Cloud Computing, Components of Cloud, Advantages & Drawbacks of Cloud Computing and also describe cloud computing in libraries. **(Rekhraj Sahu)**[3]

Bibliometric analysis of digital literacy research output in J-gate analyzed the pattern of growth of the research output published in the pattern of authorship, author productivity and subjects covered in the papers over the period 2009-2018. It found that 1601 papers were published during the period of study 2009-2018. The Maximum number of publication is from United Kingdom 452 (28.23%). The Doubling Time has shown an increasing trend and RGR has been decreased from 0.23 to 0.20. **(Rajeswari., 2019)**[4].

Research contribution of Arts faculties of Annamalai University. Studies the impact of research under different existing Social Science &Arts departments of the University and analyses the strong and weak areas of University research, collaborative nature of research in terms of the authorship pattern. The results shows that there is significant growth of research productivity in the faculty of Arts during the period of study with less collaboration. **(Rajeshwari, 2012)**[5].

Objectives:

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The main objectives of this study is to study about the research productivity of cloud computing in libraries and

1. To find out the year wise distribution of research articles on cloud computing in libraries
2. To examine the authorship pattern of research articles on cloud computing in libraries
3. To study the document wise distribution of research articles on cloud computing in libraries.
4. To find out the language wise distribution of research articles on cloud computing in libraries.
5. To identify the top 10 journals contributing to research in cloud computing in libraries
6. To identify the top 10 keywords used in research on cloud computing in libraries..
7. To study the nature of author wise contribution and determine the degree of collaboration.
8. To recognize and evaluate the related of growth of research productivity.

Methodology

Publication is essential to productivity in research, the work will be recognized only when it takes a conservative, physical form which can be received , accessed and recongised by professionals. This study aims to recognize the distribution of authorship pattern in research on cloud computing in libraries from web of science database which is a scientific and indexing service maintained by Thomson reuters. For a period of 18 years from 2002 to 2019, a total of 252 records were retrieved and analysed using histcite software application and the results are tabulated based on the objectives.

Table – 1

Details of the Data Sample on research of Cloud Computing in Libraries

During 2002 to 2019

S.No.	Details about Sample	Observed Values
1	Duration	2002 - 2019
2	Time Span	18 Years
3	Total No. of Records	252
4	Total No. of Authors	999
5	Contributed Journals	167

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6	Document Types	4
7	Languages	5
8	Frequently Used Words	1049
9	Contributing Countries	55
10	Contributing Institutions	472
11	Local Citation Score	37
12	Global Citation Score	14145

Studies related to cloud computing and its application in libraries was downloaded from Web of science database for a period of 18 years from 2002 – 2019 . 252 studies have been identified from 167 journals . a detailed bibliometric study has been studied to find out year wise, country wise, language wise, continent wise and document wise has been studied. The authorship pattern and degrees of collaboration has been analyzed in detail. ,

Table 2

Year wise contribution of Cloud Computing in Libraries research output

S.No	Year	Records	%	TLCS	TGCS
1	2002	1	0.4	0	16
2	2003	6	2.4	10	7904
3	2004	3	1.2	0	193
4	2005	3	1.2	2	1952
5	2006	1	0.4	0	46
6	2007	3	1.2	1	264
7	2009	9	3.6	1	150
8	2010	4	1.6	2	335
9	2011	9	3.6	0	40
10	2012	24	9.5	9	412
11	2013	17	6.7	2	349

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12	2014	23	9.1	2	762
13	2015	26	10.3	2	858
14	2016	18	7.1	4	289
15	2017	23	9.1	1	274
16	2018	39	15.5	1	159
17	2019	43	17.10	0	142
	Total	252	100	37	14145

In 2002 there was just one record, it started gaining momentum in the year 2012 rising to 24 records within a decade, and the table shows that 43 records were maximum in 2019. There are many reasons for the rapid growth, development of internet technology, and knowledge of cloud computing especially with costs and infrastructures. Cloud computing research has spread in various applications of computing and specially with libraries many countries have started using it.

Table 3

Document wise contribution of Cloud Computing in Libraries research output

S.No	Documents	Records	%	TLCS	TGCS
1	Article	225	89.2	27	6109
2	Review	15	6.0	10	7976
3	Article; Proceedings Paper	10	4.0	0	59
4	Article; Early Access	2	0.8	0	1
	Total	252	100	37	14145

When studying about the different document types, 4 types of documents were found in these 252 publications, the most frequent being article type having 225 records accounting for 89.2%, 2nd position was review articles, and the least was article early access and it was just 2 records ,i.e.0.8%

Table 4

Language wise contribution of Cloud Computing in Libraries research output

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S.No	Language	Records	%	TLCS	TGCS
1	English	245	97.2	37	14125
2	Spanish	4	1.6	0	18
3	Chinese	1	0.4	0	0
4	French	1	0.4	0	0
5	Portuguese	1	0.4	0	2
	Total	252	100	37	14145

Language is significant medium to disseminate the scientific producitivity in any subject areas. Based on language wise contribution, from a total of 252 records related to cloud computing it was found that maximum 245, 97.2%records were in English language, 4 records were in Spanish and Chinese, French, Portuguese had just a record each respectively.

Table 5

Number of Author wise contribution of cloud computing in libraries research output.

Authors	Records	%
One	25	9.92
Two	46	18.25
Three	56	22.22
Four	28	11.11
Five	29	11.50
Six	25	9.92
Seven	24	9.52
Eight	4	1.59
Nine	4	1.59
Ten	4	1.59
Above Ten	7	2.79
	252	100

From a total of 252 records on cloud computing in libraries it is found that maximum of 56 records 22.22% of them were authored by 3 authors. And 4 records were authored by eight, nine and ten authors each.

Table 6

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Authorship pattern of contribution on Cloud Computing in Libraries research output

Year/Authorship		I	II	III	IV	V	VI	VII	VIII	IX	X	Above X	Total	CI
2002	Article	-	-	-	-	-	1	-	-	-	-	-	1	6.00
	Authors	-	-	-	-	-	6	-	-	-	-	-	6	
2003	Article	-	3	-	1	1	1	-	-	-	-	-	6	3.5
	Authors	-	6	-	4	5	6	-	-	-	-	-	21	
2004	Article	-	2	-	-	-	-	1	-	-	-	-	3	3.67
	Authors	-	4	-	-	-	-	7	-	-	-	-	11	
2005	Article	-	-	1	-	1	-	-	-	-	1	-	3	8.00
	Authors	-	-	3	-	5	6	-	-	-	10	-	24	
2006	Article	-	-	-	1	-	-	-	-	-	-	-	1	4.00
	Authors	-	-	-	4	-	-	-	-	-	-	-	4	
2007	Article	-	1	-	1	-	-	1	-	-	-	-	3	4.33
	Authors	-	2	-	4	-	-	7	-	-	-	-	13	
2009	Article	2	2	2	2	-	1	-	-	-	-	-	9	2.89
	Authors	2	4	6	8	-	6	-	-	-	-	-	26	
2010	Article	1	-	1	-	1	-	-	1	-	-	-	4	4.25
	Authors	1	-	3	-	5	-	-	8	-	-	-	17	
2011	Article	1	1	1	1	2	-	-	-	-	2	1	9	6.22
	Authors	1	2	3	4	10	-	-	-	-	20	16	56	
2012	Article	5	5	6	1	1	3	2	-	-	-	1	24	3.54
	Authors	5	10	18	4	5	18	14	-	-	-	11	85	
2013	Article	4	5	5	-	1	-	1	-	-	-	1	17	3.23
	Authors	4	10	15	-	5	-	7	-	-	-	14	55	
2014	Article	4	5	5	-	1	-	7	-	-	-	1	23	4.22
	Authors	4	10	15	-	5	-	49	-	-	-	14	97	
2015	Article	1	7	3	3	4	6	1	1	-	-	-	26	4.12
	Authors	1	14	9	12	20	36	7	8	-	-	-	107	
2016	Article	1	2	8	-	2	1	3	-	1	-	-	18	4.17
	Authors	1	4	24	-	10	6	21	-	9	-	-	75	
2017	Article	1	2	5	2	5	5	2	-	-	-	1	23	5.00
	Authors	1	4	15	8	25	30	14	-	-	-	18	115	
2018	Article	2	6	12	7	4	3	3	-	1	-	1	39	4.05
	Authors	2	12	36	28	20	18	21	-	9	-	12	158	
2019	Article	3	5	7	9	6	4	3	2	2	1	1	43	

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	Authors	3	10	21	36	30	24	21	16	18	10	11	199	4.63
Total	Article	25	46	56	28	29	25	24	4	4	4	7	252	4.22
	Authors	25	92	168	112	145	150	168	32	36	40	96	1064	

*Collaborative index

Co-authorship research is an important aspect if bibliometrics and the level of research collobaration is an index to assess the current status of research in a specific field. The table shows that there are 252 records from 2002 to 2019. Total 1064 authors have contributed the cloud computing in Libraries. Among those only 25 authors have been published by single authored article and higest articles 5 at the year of 2012. It could be noted from this authorship analysis three authors and seven authors contribution is highest than other collaborative authors contribution. Nearly 90% of articles were contributed by collaborative authorship pattern.

Table 7

Calculation of degree of Collaboration

Authors	Publication	Percentage
Single Author	25	9.92
Multiple Authors	227	90.08
	252	100

Based on this study, the result of the degree of collaboration C = 0.90.i.e, 88 percent of collaborative authors articles published during the study periods. The degree of collaboration is calculated by using the following formula (K.Subramanyam, 1982)[6]:

C= Degree of Collaboration Nm = Number of multiple authors Ns = Number of single authors

C= Nm ÷ (Nm + Ns)

C= 227/252

C= 0.90

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In the present study the value of C= 0.90 As a result, it was found that the degree of collaboration in the cloud computing in libraries is 0.90. This openly indicates its dominance upon multiple contributions

Table 8

Related Growth rate and Doubling time of Cloud Computing in Libraries research output

Year	Records	$Loge^{1p}$	$loge^{2p}$	RGR	Dt(P)
2002	1	-	0	0	0
2003	6	0	1.79	1.79	0.39
2004	3	1.79	1.09	-0.70	-0.99
2005	3	1.09	1.09	0	0
2006	1	1.09	0	-1.09	-0.64
2007	3	0	1.09	1.09	0.64
2009	9	1.09	2.20	1.11	0.62
2010	4	2.20	1.39	-0.81	-0.86
2011	9	1.39	2.20	0.81	0.86
2012	24	2.20	3.18	0.98	0.71
2013	17	3.18	2.83	-0.35	-1.98
2014	23	2.83	3.14	0.31	2.24
2015	26	3.14	3.26	0.12	5.78
2016	18	3.26	2.89	-0.37	1.87
2017	23	2.89	3.14	0.25	2.77
2018	39	3.14	3.66	0.52	1.33
2019	43	3.66	3.76	0.10	6.93

Table VII It shows that the relative growth rate and doubling time of Cloud Computing in Libraries from the period of 2002 to 2019. It could be observed that the relative growth rates have increased from 0 in 2002 to 0.10 in 2019. Doubling time is also in increased trends.

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Table 9

Research output of Cloud Computing in Libraries Continent Wise

S.No	Country	Records	TLCS	TGCS
1	Asia	95	7	1359
2	Africa	7	0	68
3	Europe	143	33	13418
4	North America	100	12	4047
5	South America	10	0	231
6	Australia	22	7	570
	Total	377	59	19693

With regard to 252 records on cloud computing in libraries, the continent wise distribution shows that Europe has the highest record that is 143 , followed by north America 100 records, Asia 95 records and the least was from Africa only 7 records.

Table -10

Top10 Country wise contribution of Cloud Computing in Libraries research output.

S.No	Language	Records	TLCS	TGCS
1	USA	90	10	3874
2	Peoples R China	39	0	450
3	Australia	22	7	570
4	UK	20	3	2241
5	Spain	19	3	939
6	Germany	18	4	495
7	France	12	11	7948
8	Italy	11	2	569
9	South Korea	10	1	52
10	Canada	8	1	158

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Table 10 shows the top 10 countries research output on cloud computer in libraries, it is found that USA stands first with 90 records, and the least is from Canada with only 8 records.

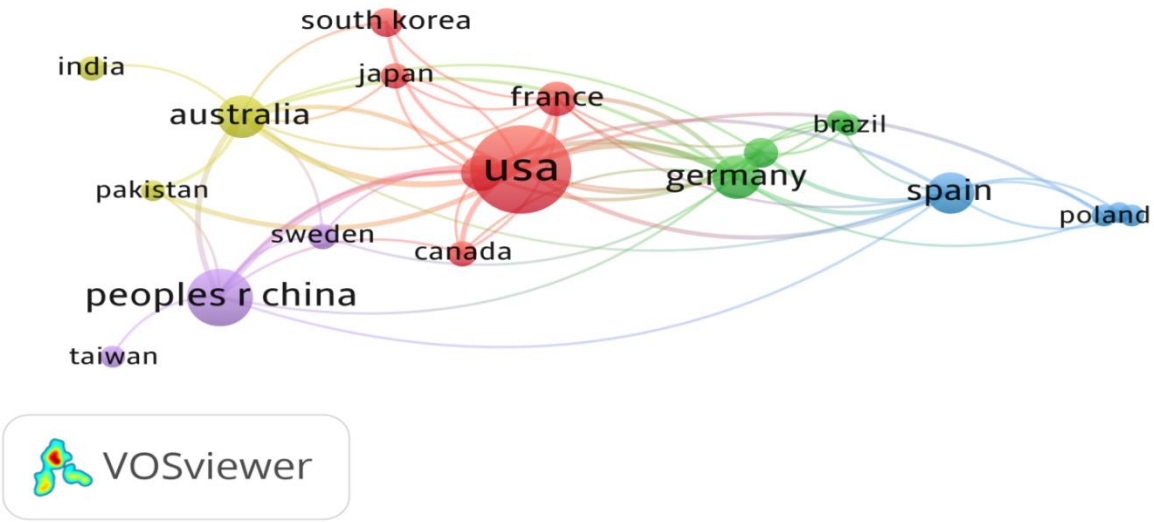

Figure1 Country wise contribution of cloud computing in libraries

Table 11

Top 10 Journals contribution of Cloud Computing in Libraries

S.No	Journals	Records	TLCS	TGCS
1	Astronomy & Astrophysics	9	2	1799
2	Ieee Access	9	1	6
3	Monthly Notices Of The Royal Astronomical Society	7	10	6825
4	Bmc Bioinformatics	6	0	141
5	Future Generation Computer Systems-The International Journal Of Escience	5	2	106
6	Library Hi Tech	5	1	20
7	Bioinformatics	4	3	181
8	Computer Physics Communications	4	0	36

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9	Concurrency And Computation-Practice & Experience	4	0	16
10	Software-Practice & Experience	4	0	14

The top 10 journals contributing towards cloud computing in libraires list has been given in table 11. Journal of Astronomy and astrophysics have a maximum of 9 records and in 1st position and 4 journals namely Bioinformtics, computer physics information communication , Concurrency And Computation-Practice & Experience, Software-Practice & Experience have a minimum of 4 records.

Table 12

Top 10 Keywords contribution of Cloud Computing in Libraries

S.No	Words	Records	TLCS	TGCS
1	Cloud	92	13	1727
2	Computing	49	3	851
3	Based	39	4	347
4	Data	32	11	2497
5	Library	25	1	346
6	Using	16	1	141
7	Environment	15	1	217
8	Platform	14	0	65
9	Services	13	4	147
10	Big	12	3	377

Keywords play an important role in accessing the article, the top 10 keywords used in these 252 records are listed in table -12 cloud is the important key word in 92 records , followed by computing and the least used key word was big in 12 records.

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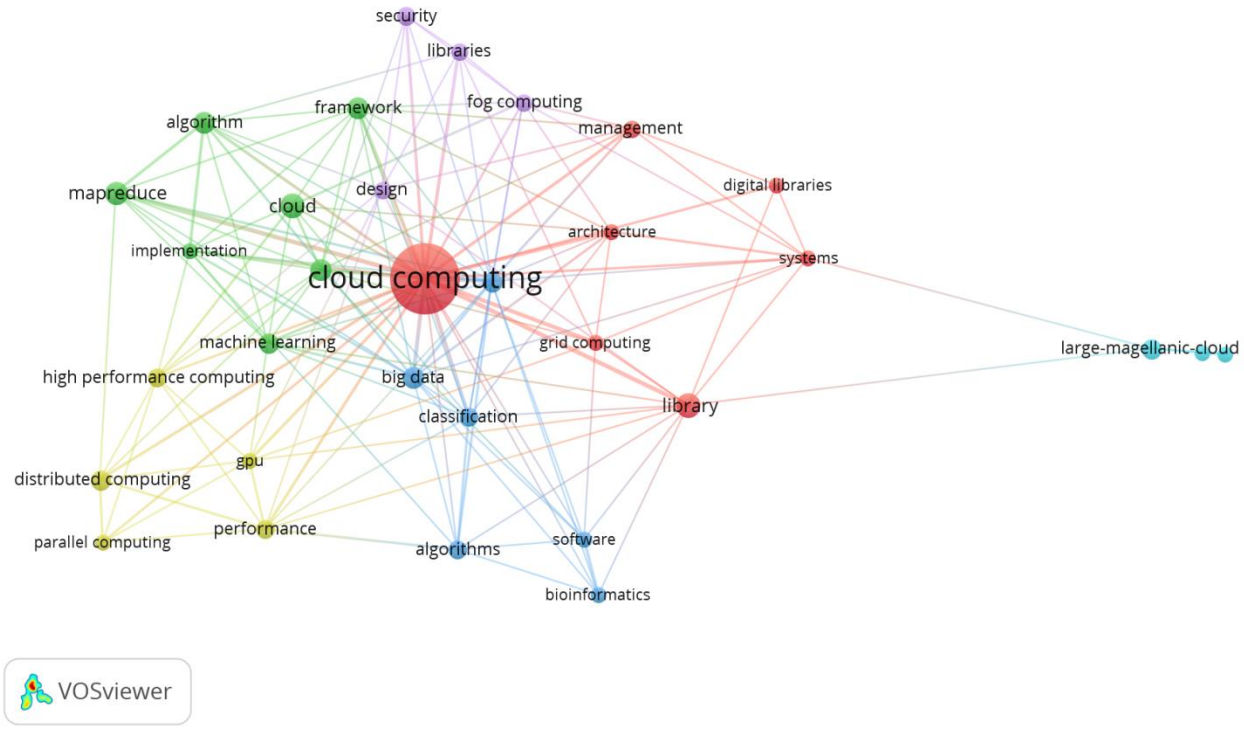

Figure 2 Keyword wise contribution of cloud computing in libraries

Findings

- The finding of growth rate of cloud computing in libraries research output during the study period is in increasing trends.
- The finding of the annual contribution of cloud computing in libraries is highest in the year 2019.
- The finding of the author contribution of cloud computing in libraries is highest by multiple authors.
- The finding of the Document wise highest contribution is in the form of articles.
- The findings of the Language wise maximum contribution is in English language.

Conclusion

The data for the study has been taken from web of science database for contribution to cloud computing in libraries. Present study explored the scientific analysis of cloud computing in

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libraries for the period 2002 to 2019. The study revealed that the highest numbers of papers were contributed by multi authors, whereas the remaining papers were produced by a single author. The maximum numbers of scholarly articles were published in 2019. Whereas the minimum numbers of articles were in 2002. The study period research publication had increased trends. Many researchers are doing in this field. Now a days globally younger researcher research selected this topic.

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